CONSERVATION PRACTICE STANDARD

CONSTRUCTED WETLAND

(No.)

CODE 656

DEFINITION

A constructed shallow water ecosystem designed to simulate natural wetlands.

PURPOSE

To reduce the pollution potential of runoff and wastewater from agricultural lands and livestock operations to water resources.

CONDITIONS WHERE PRACTICE APPLIES

- Where a constructed wetland is a component of a planned conservation system or agricultural waste management system
- Where wastewater or runoff originates from agricultural lands including livestock or aquaculture facilities
- Where a constructed wetland can be constructed, operated and maintained without polluting air or water resources

This practice does not apply to: ponds (378); wetland restoration (657); wetland creation (658); or wetland enhancement (659).

CRITERIA

General Criteria Applicable To All Purposes

Laws and Regulations. All federal, state, and local laws, rules and regulations governing the use of constructed wetlands and the management of agricultural wastewater must be followed. Constructed wetlands for waste treatment shall not be designed to discharge to waters of the state unless permitted by state laws and regulations, and appropriate permits have been obtained by the landowner to do so. In addition, if discharge is permitted, the receiving surface water must have the capacity to assimilate the constructed wetland's effluent during low flow periods.

Location. Constructed wetlands shall be located outside the limits of wetlands of any classification.

Constructed wetlands located within a floodplain shall be protected from inundation or damage from a 25-year flood event, or larger if required by laws, rules, and regulations.

Constructed wetlands shall be located to provide sufficient separation distances from structures such as residences and commercial buildings so prevailing winds and landscape elements such as building arrangement, landforms, and vegetation will minimize odors and protect aesthetic values. They shall be located with a separation distance that will minimize the potential for contamination of ground water resources. This distance shall be in accordance with laws, rules and regulations.

Type. Constructed wetlands shall be designed as surface flow systems

consisting of adequate seepage control, a suitable plant medium, rooted emergent hydrophytic vegetation, and the structural components needed to contain and control the flow.

Influent. The influent to the constructed wetland shall be pretreated to reduce the concentrations of solids, organics, and nutrients to levels that will be tolerated by the wetland system and not cause excessive accretion within the wetland.

Where significant sediment and organic debris are expected in the wastewater or runoff to be treated, provisions for its entrapment before entry into the wetland must be provided.

A wetland that will receive mixed influent (wastewater and runoff) shall meet the criteria for both purposes.

Water budget. A water budget that evaluates runoff or wastewater volumes, precipitation, evaporation, seepage loss, and water use shall be used to determine the required hydraulic retention time in the wetland, storage requirements of the wetland pretreatment and post treatment facilities when included, and the possible need for supplemental water.

Embankment. The perimeter embankment shall have a minimum top width of 10 feet. Interior embankments shall have a minimum top width of 8 feet. If site conditions or owner preference result in a narrower top width, the Operation and Maintenance plan must reflect the additional effort required for vegetation maintenance and embankment repair. All embankment side slopes shall be a minimum of a 2 horizontal to 1 vertical.

Vegetation. Vegetation selected for the constructed wetland shall be hydrophytic plants suitable for local climatic conditions and tolerant of the concentrations of nutrients, pesticides, and other constituents in the runoff or wastewater stream and selected for their treatment potential. Preference shall be given to native wetland plants with localized genetic material. Plant materials collected or grown from material collected within the same Major Land Resource Area (MLRA) are considered local.

Planting medium. The soil used for the planting medium shall have a cation exchange capacity, pH, electrical conductivity, soil organic matter, and textural class that is conducive to wetland plant growth and retention of contaminants.

Seepage control. The constructed wetland shall be located in soils with an acceptable permeability that meets all applicable regulations, or it shall be lined in accordance with Standard 521. Measures for controlling seepage with a soil liner shall be designed according to the procedures of NEH Part 651, Agricultural Waste Management Field Handbook, Appendix 10d, "Geotechnical Design and Construction Guidelines." The use of soil dispersants shall conform to standard PA512B, and the use of bentonite shall conform to standard PA521C.

A flexible membrane liner conforming to standard PA521A may be used in place of a soil liner.

Livestock shall be excluded from the wetland.

Additional Criteria for Wetlands Constructed for Wastewater Treatment

Applicability. The criteria in this section applies to all wetlands constructed to treat effluent from waste storage facilities and waste treatment lagoons, wastewater from milking operations and on-farm food processing, silage leachate, and runoff

from barnyards, feedlots and other non-vegetated animal concentration areas.

Topography. Site topography shall accommodate the requirements for length to width ratios of the wetland and the wetland cells, and the requirement that the wetland cells be level side to side with grades of less than 0.005 ft/ft lengthwise.

Inlet. An inlet structure that will allow control of flow discharged to the wetland and screening of influent to prevent debris from entering the wetland shall be provided. Design of the inlet structure shall assure its function throughout the life of the wetland considering accretion.

Influent. Constructed wetlands for wastewater treatment shall not allow for direct inflow of contaminated and/or uncontaminated runoff. Runoff water may only be used as supplemental water as determined by the water budget, and must be introduced to the wetland at a controlled rate. If contaminated runoff is included, the waste load in it shall be included in the design of the wetland.

All wastewater shall flow through a pre-treatment tank or basin to settle solids, mix and/or dilute wastewater, and regulate the flow into the wetland.

Surface Area. The surface area of the wetland shall be determined using NEH Part 637, Environmental Engineering, Chapter 3, "Constructed Wetlands." Influent concentration and volume, operating temperatures, the desired level of treatment, and the planned disposition of the effluent shall be factored into the design.

Configuration. Individual cells within the constructed wetland shall have a length-to-width ratio of 10:1 to 15:1. The wetland shall consist of at least two rows of parallel cells, unless the resultant cells would be less than 10 feet wide. A constructed wetland with parallel cells shall have an overall length to width ratio of 1:1 to 5:1.

Inlet and outlet plumbing shall be configured to allow any of the parallel cells to continue to operate if all the others are shut down for repairs, resting, replanting, etc.

Flow depth. The design depth shall be based on the most severe season of operation, the desired level of treatment, and the required littoral zone of the plant species being used. The design depth shall be a minimum of 0.33 ft. and a maximum of 1.5 ft.

Embankments. Height of the constructed wetland perimeter embankment shall be the sum of the following:

- Design depth
- Wetland accretion -- a minimum of 0.5 inch per year for the design life
- 25-year, 24-hour precipitation
- 12 inches of freeboard

The height of the wetland's interior embankments shall be, at a minimum, the sum of the following:

- Normal design flow depth
- Wetland accretion -- minimum of 0.5 inch per year for the design life

Overflow Device. An ungated overflow device shall be provided to operate when the 25-year, 24-hour precipitation is exceeded. The overflow device shall operate without infringing on the wetland perimeter embankment's freeboard.

Outlet. Constructed wetlands will discharge to wastewater treatment strips (635) or storage facilities (313) to allow for land application, or the effluent shall be recycled through the waste management

system. Discharge to waters of the Commonwealth is allowed only if permitted by federal, state and local regulations.

An outlet structure shall be provided that allows maintenance of proper water level in the wetland and controls the flow from the wetland.

Additional Criteria for Wetlands Constructed for Runoff Treatment

Applicability. The criteria in this section applies to runoff from cropland, pasture, vegetated animal concentration areas including rotational exercise lots, and composting facilities.

Treatment Design Storm. The constructed wetland system shall be designed to contain the runoff from the 2-year, 24-hour storm above any permanent pool depth, which shall be limited to no more than 18 inches. Limited area sites (less than 0.25 acre) handling only the "first flush" volume shall have a minimum capacity to store 0.5 inch of runoff volume from the entire drainage area.
When less than full 2-year runoff is stored, bypass of the excess storm flow shall be provided. All bypassed flow and runoff in excess of the 2-year storm and up to the 25-year storm shall be adequately handled in other treatment or storage facilities, as applicable.
In all cases, the "Design Criteria for Wetland Restoration Embankments" in the PA378 (Pond) standard shall be met.
Uncontaminated runoff shall be excluded from the wetland, unless it is stored in a separate pond (PA378) and used as supplemental water during dry periods.

Detention time and surface area. The detention time and surface area shall be calculated to achieve the required level of treatment based on the limiting contaminant present, using NEH Part 637, Environmental Engineering, Chapter 3, "Constructed Wetlands." Influent concentration and volume, operating temperatures, the desired level of treatment, and the planned disposition of the effluent shall be factored into the design.

Wetland Cells. Length-to-width ratios are to be 4:1 to 10:1. Other dimensions and shapes that provide a more natural landscape appearance that meet treatment requirements can be used.
The standard for Dike (356) shall be used as appropriate. Refer to the Engineering Field Handbook, Chapter 13, "Wetland Restoration, Enhancement, and Creation," and Chapter 6, "Structures," for design information. Existing drainage systems will be utilized, removed, or modified as needed to achieve the intended purpose.

Depth. Maximum permanent water depth shall be 18 inches except in those instances where deep water areas up to four feet are included as a special design feature to redistribute flow across the wetland cell, or to serve as a sump at the outlet end. In no case shall the deepened sections total more than ten percent of the surface area of the wetland cell.

Outlet. A water control structure to automatically regulate storage release in accordance with the design detention time shall be installed. The outlet shall direct effluent to a land application area, a wastewater treatment strip (PA635) or a storage facility (PA313), as applicable, based on the content of the effluent and the proximity to water bodies.

CONSIDERATIONS

Locate constructed wetlands downgrade and as near the source of wastewater as practical.

If there is a concern about adverse interaction between wildlife and the wetland, install measures to exclude or minimize attractiveness of the constructed wetland to wildlife. Take measures, where appropriate, to exclude burrowing animals that may frequent the wetland.

Consider the use of fences as an exclusion measure.

Recycle constructed wetland effluent back through the agricultural waste management system when practical.

Consideration should be given to storage of wastewater during winter months instead of wetland operation.

Add additional height to embankments to accommodate accumulated ice during winter operation of constructed wetlands.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use. Plans shall include construction sequence, vegetation establishment, and management and maintenance requirements.

OPERATION AND MAINTENANCE

A site specific operation and maintenance plan shall be developed for and reviewed with the landowner or operator prior to installation of the constructed wetland. The plan shall be consistent with the purposes of the practice, its intended life, safety requirements, and the design.

Operational requirements should include:

- Maintenance of water levels appropriate for vegetation
- Control of flow and water levels according to the water budget
- Monitoring of wetland performance
- Sampling effluent for nutrients prior to utilization, where applicable
- Surveillance of inlet and outlet devices

Maintenance requirements should include:

- Removal of solids and debris from settling facilities and flow control devices
- Repair of embankments
- Control and replacement of vegetation in the wetland cells and on the embankments
- Repair of fences or other ancillary features
- Repair of pipelines
- Control of unwanted animals (varmints) or vectors (mosquitoes)